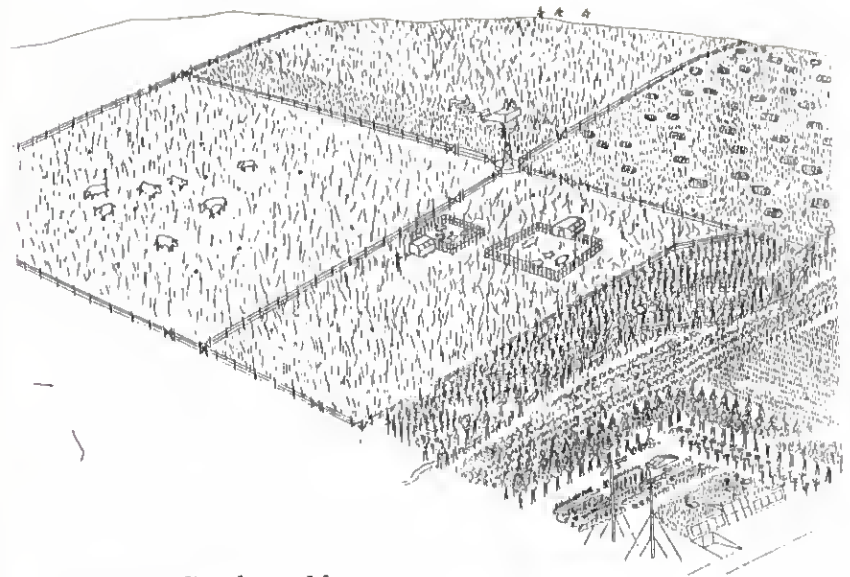

Looking Back to Now

Wes Jackson

The year is 20[illegible] with a heightened consciousness. People everywhere—on farms, in villages, and in cities—have sustainability as their central paradigm. They think globally and act locally. Regional semi-self-sufficiency is emphasized but the principles of the New Age farmers are the same from New England to Southern California. Our utopian farm is in Kansas, below the 39th parallel and east of the 98th meridian. The area averages about 28 inches of rainfall each year, but the evaporation is in excess of rainfall. This is farming country that before being plowed more than a century ago was biotically rich. Stories handed down through the grandparents tell school-age children how the breaking of this virgin sod sounded like the opening of a zipper. A few miles east is the western edge of the vast Tallgrass Prairie, dominated by such species as big bluestem, Indian grass, and switchgrass. Scarcely 30 miles to the west are the mixed prairies dominated by bluestem and sideoats grama.

Because of the minimal landscape relief, the Great Plains is one of the few regions where it makes sense to divide the land into one-mile-square parcels. A road surrounds almost every square mile. This is a land that after the "Great Plowing" in the early 1900s supported such high-producing annual crops as wheat, sorghum, milo, and soybeans. Between then and 1990 only native pastureland and roadsides carried the principal grasses that were characteristic of the region before the Europeans arrived. Even so, this prairie, mostly because of forced grazing, had long since lost 20 or 25 native prairie species. What was left was not prairie but grassland. During most of the last century, wheat was an important export crop for the region; we are fortunate that even more grassland wasn't plowed. Church leaders, farmers, and grain men had said that we must sell grain to feed a hungry world. It was mostly a moral veneer over a basically economic consideration, but it was enough to discourage the initial development of mixed perennials. Traditional crops were proven producers regardless of their tremendous toll on finite energy resources, soil, and, for western corn growers, fossil ground water.

But now in 2030 the settlement pattern differs drastically from what it was in 1980. In this immediate area, each family lives on 160 acres, or four families per square mile (640 acres). The

dwellings of all four families are near the middle of the square-mile section but on their own property. Therefore, within 200–300 yards of each other there are 16–20 people. Their small village and main trading center, which includes both school and churches, is 2½ miles away. No one in the rural service area of the village is ever any farther away. The village's service area covers 16 square miles (4 miles on each side), which includes 64 farm families totaling about 250 people. Westward, in the mixed prairie, one-half of a section (320 acres) is needed to support a single family, and nearly 200 miles west of the mixed-grass country, in the short-grass prairie, 2 square miles is usually necessary to support one family. Eastward and in some of the west, it is another story. Along the Missouri in Nebraska; the southwestern half of Minnesota, most of Iowa, in southeastern Wisconsin, northern Indiana, northwestern Ohio, east central Michigan, along the Mississippi, in western Tennessee and northwestern Mississippi, in much of the Sacramento Valley, as well as in numerous other localized areas throughout the country, often fewer than 10 acres but never more than 20 is enough to support a family. It is not that production is always higher than in our area, it is just that a combination of factors, including rainfall, makes a sustainable yield more assured. The carrying capacity of the land is so varied that when we say the average farm, nationwide, is 40 acres, we must immediately realize the limited meaning of that statistic.

Regardless of farm size, the village population seldom exceeds the farm population by more than a factor of two. An entire community in our region consists of around 750 people, including the 260 people on farms. Let us compare this to the distribution pattern nationwide. The population of the United States is around 300 million and is scheduled to stabilize completely in the next seven years, in spite of the fact that zero population growth procedures have been in effect since the early 1980s. The momentum of that past is still with us, though insignificantly so. But it is the distribution of the population that has been radically altered over the last 50 years. Most of the major cities have experienced drastic declines and the number of cities of 40,000 or less has greatly increased. Optimum city size was widely discussed in the last century. Many of the New Age pioneers concluded, though there was nothing like unanimous agreement, that much of the social pathology of our former urban areas could be attributed to the spiritual dangers that arise when people no longer know or feel their rootedness in the land. When heat comes from a furnace, food from a grocery store, building materials from the lumber yard, and the automobile from the showroom floor, the spiritual loss is devastating to the society. It doesn't necessarily take a city of a million, many concluded, to provide the "critical mass" necessary to help a large number of humans live up to a broad spectrum of their innate potentialities. A population of 40,000 seems to have a special associated energy. When the cathedral of Notre Dame on the Île de France was begun, the population of Paris was 35,000. Renaissance Florence had a population of 35,000–40,000. Regional cities now seldom exceed 40,000, and there are somewhat fewer than 4,000 such cities totaling fewer than 160 million people. Of course, some of the major cities still contain a few million people, but they are mostly emptied and much of the area now produces food, clothing, and shelter where concrete and stone formerly dominated the environment. The civilization was a long time learning that, by and large, the only people who really liked big-city life were merchants and intellectuals.

Of the 300 million people in the United States, some 20 million, or about one-fifteenth of the population, work in the rural areas not associated with rangeland and forestry. Nearly 10 million families, totaling about 40 million people, are living on 400 million acres of cropland. This amounts to a little over 13 percent of the total population, well over twice the percentage of 50 years ago and nearly three times the total rural population of that time. The rural villages, however, contain twice as many people as the countryside they support. I mentioned earlier that the land holdings vary drastically in size. For example, in much of northeastern Illinois, a family of four can live on 5 acres. This amounts to 128 small farms or 512 people per square mile. This is a very high density, but the productivity of the land is the determining factor. Over 8,000 people live within the 16 square mile rural service area. Its supporting village has over 16,000 people.

Our solar village of 500 or so is necessarily different from the northeastern Illinois village of 16,000. Aside from the differing political dynamics associated with different sizes and densities, there is a commonness of purpose best reflected in the numerous bioshelters that grow what might be described as a healthful diet, though not an abundance of calories. The fields provide most of the protein and carbohydrates for this society, and it is up to the people in the villages and cities to provide vegetables and fruits and a certain amount of protein, mostly from fish, in the passive bioshelters pioneered by the New Alchemists in the last century. The major differences among these villages have to do with the regional responses of village people in their work with farmers to meet

another in a rhythm that does not jeopardize flowering and seed set. Most grazing does occur in areas that produce seed for human consumption, but certain polycultures are grown for the livestock exclusively. A few weeks before slaughter buffalo/beef graze on mixed perennials that are setting seed. This is a weak simulation of the feedlot of former times. No hay is hauled to the barn for winter feeding, for there is no barn. Some of the hay is windrowed with a side-delivery rake and is left, but most raked hay is rolled into 1,000–1,200 pound bales and remains in the field. This system reduces the need to spend time and energy moving hay and manure, and the nutrients are left where they are most useful.

The movement of livestock on the farm turns out to be critical. In natural ecosystems there were no fences. Even though we are forced to use fences for all our livestock, our management program recognizes that animal wastes on th[illegible] contribute to the crumb structure of the soil as mentioned earlier, which allows the soil to release nutrients slowly while holding moisture.

Many of the problems caused by farming techniques of the 1960s and 1970s have been solved in this new era. Seedbed preparation occurs mostly where the few acres of annuals are grown, and since tillage has been dramatically reduced, soil loss is almost nonexistent. Silting of streams is minimal, and more species and larger populations of fish thrive in the waterways. Energy-expensive terracing is no longer as necessary, and where check dams and [illegible] pools exist, they serve the farmer mostly as pools for catfish culture. Irrigation is reduced, for the perennial polycultures slow the water so thoroughly that hundreds of thousands of springs throughout the country have been reborn. Fertilizer application is minimal because the diversity of crops has maintained a better nutrient balance with less nutrient runoff. The recordbreaking fish kills of the last century due to fertilizer and feedlot runoff are now only part of the legends about our unenlightened grandparents. Weeding is essentially a thing of the past, except in gardens and where annual monocultures are grown. Pesticide application is almost nonexistent because of both polyculture and a broader genetic base in our crops. A broader genetic base in livestock and the demise of high-density feedlots have made the use of antibiotics for livestock seldom necessary. The life of farm machinery has increased by a factor of 16 in the last 50 years. All of these changes have resulted in a drastic cut in energy consumption for farm production.

The major changes began to surface during the 1980s, when a few young agricultural professionals, having adopted a sustainable agriculture as their paradigm, looked for the sustainable alternatives rather than placing their bets on corporately controlled agriculture. In many respects, they were the true heroes of the era. Some took the theory of the quantitative gene developed during the 1960s and, using it along with the known virtues of hybrid vigor, made repeated breakthroughs in new crop development.

There was a unifying theme from Massachusetts to Kansas to California. People recognized that in the long run, and often in the short run, land is the determining factor. Citizens sought to meet the expectations of the land and to look at the natural ecosystems of different regions as the standards against which to judge their agricultural practices. Suddenly, as is so often the case with profound statements, there was a new meaning to the words that Thoreau had uttered from the Concord Lyceum in the mid-1800s: "In wilderness is the preservation of the world." The policy-makers began to take seriously the prediction of Charles Lindberg: "The human future depends on our ability to combine the knowledge of science with the wisdom of wildness." When this concept was applied to our farms, they became waterproof, diversified family hearths. Our fields are no longer vulnerable, oil-hungry monocultures, although they are not wilderness either. But without wilderness, we would not have developed a sustainable agriculture and culture.

the expectations of the land. A pluralistic society does not preclude the possibility of holding a common allegiance.

Neither does pluralism mean that certain patterns of both young and old cannot be similar everywhere. Throughout the country, older people have the option of living in the village, but their presence is cherished on the farm. Nearly all have chosen to live in the village, but most return to the farm daily to assist their families and neighbors in various chores. These are the people who play the most important part in the children's education.

Most communities now emphasize the value of history, and history becomes more real when adults tell personal stories that link the past to the present. The stories are about heroes, the prophets of the solar age, and the pioneers in the era of decentralization and land resettlement, and villains who were responsible for chemical contamination of the land and its people. The older people tell of a past in which nuclear power was tried, discovered to be filled with unresolvable uncertainties, and abandoned. Many of these older people lived during what is now called the "Age of the Recognition of Limits." These former doom-watching pioneers were like the children of Israel who had escaped the grasp of the Egyptians and then wandered in the wilderness for 40 years, saddled with their own slave mentality, waiting for a new generation of free minds to develop and be fit for life in the promised land." Many of the pioneers have readily admitted their earlier addiction to all the consumer products of affluence, and work hard at teaching their young the true source of sustenance and health—the land. They are living reminders that this sun-powered civilization has arrived as the result of nothing less than a religious reformation.

The strong new land ethic has resulted in a different concept of land ownership. Under the land-trust system, land is not owned by individuals in the same sense that it was 50 years ago. Nevertheless, it can be passed on from one generation to the next, and people have a strong sense of ownership. They cannot do exactly as they please with the property. They cannot willfully pollute it with toxic chemicals, sell it off for housing developments, or in any way speculate with it. Such wasteful exploitation discounts too much of the future. Activity that is potentially destructive is prohibited by a board of nonfarming elders from the village and two from the regional city. Both sexes are equally represented.

On our farm, the well-insulated house is partially underground and is equipped with both passive and active solar installations for hot water and space heating. Though it is 100 percent solar, a backup system consisting of a wood-burning stove is in place. A water-pumping windmill and two wind-electric systems provide power for the farmstead. A combination of technologies from the past are appropriate for the farm's water system. A water-pumping windmill pumps water, which is stored in tanks for the livestock and household use. Trenching machines and plastic pipe are used to deliver the water wherever needed for human convenience. One wind generator takes care of all refrigeration needs and simply cools the freezer and refrigerator when the wind is blowing. Since the refrigerator itself is the "accumulator," no batteries are needed. The other wind-electric system consists of an induction motor that kicks in when the output of the wind-powered generator is greater than the load on the service line. The induction motor, which is similar to that found on washing machines in the 1930s, is plugged into the wall receptacle and runs the kilowatt-hour meter backward, giving the farmstead an electrical energy credit. A special meter records the numbers of hours generated. If this household wishes to break even on the utility bill, its unit must provide four kilowatts of electricity to a privately owned utility for each one it receives. There is just enough electricity generated in the area from both wind and low-head hydroelectric turbines to supply the needs of the countryside, village, and regional city. This is because in the last 50 years, solar power for space and hot water heating has become so widespread. In combination with the appropriate design and construction of new shelters, heating needs have been met with a modest amount of wood, grown for the specific purpose of backing up the solar systems.

In the 20 acres of creek bottom land, people grow such annual monocultures as wheat, corn, rye, barley, and oats. Orchards and vegetable gardens are near the houses. Canning of garden products takes place outside, using energy derived from concentrating collectors. Dried foods take precedence over canned foods, and root crops are very important.

A single solar hog house on wheels is large enough to accommodate no more than 2 sows and 20 feeder pigs. A similar solar chicken house, surrounded by a 25 square foot fence accommodates from 25 to 50 chickens. About half are frying chickens, which are eaten during the summer months. Unlike the chickens grown in closed confinement 50 years ago, these animals experience far fewer tumors, and the yolks of their eggs are a brilliant gold.

Pigs and chickens "graze" on fresh pasture during the growing season. Their mobile pens are

easily advanced a few feet each day with hand levers operated by schoolchildren or grandparents from the village. The mobile pens allow for an economy of fencing materials. This managed migration simulates the migration of large animals in presettlement times. Only the breeding stock for pigs, the laying hens, and two roosters are maintained throughout the winter.

The one large outbuilding is devoted to covering the small amount of machinery. The expensive equipment consists of a small, multiple-harvesting combine, a 45 horsepower tractor, and a hay baler. The combine with a 7 foot cutter bar runs off the tractor's power take-off.

The traction and transportation fuel needs are met with alcohol, derived from crops grown on the farm. The "Fuel 40" is the principal energy producer. This is a six-species polyculture consisting of five grasses and one legume. These species are selected for their high carbohydrate content and relatively low protein yield. This 40 acre field averages about 20 barrels of crude oil equivalent per year.[1] Livestock are cycled onto this acreage for a few weeks each year to enhance the crumb structure of the soil.

One hundred years ago, approximately 25 percent of the total acreage was devoted to horses and mules for traction purposes. Now, about eight barrels of crude equivalent, or only 10 percent of the total acreage on the farm, is devoted to farm traction. This is because horses and mules would burn energy just standing around being horses and mules, but the tractor can be turned off. However, the tractor cannot become pregnant and build a replacement on solar energy. A pregnant mare at rest is not really resting. Furthermore, parts wear out on the tractor and cannot be replaced by ordinary cell division as with the traction animal. Nevertheless, from the point of view of total energy expenditure, the tractor is used rather than the beast of burden, so long as other livestock are around to enhance the crumb structure of the soil. The other 12 barrel equivalents from the Fuel 40, representing about 15 percent of the total acreage, are sent to the village and city for their portable liquid fuel needs.

The alcohol fuel "refinery" requires some elaboration. Organic material produced at the farm is delivered to a privately owned or co-op still in the village. The production of portable liquid fuels is part of a fine-grained approach to our overall energy needs. It has become economically feasible as farming methods have become less energy-intensive and less capital-intensive. It wasn't economically feasible in the 1980s and produced a very low net energy yield, but the agricultural sector was enthusiastic about producing alcohol fuel from farm crops. Hundreds of on-farm stills were built and closed down in 18 months, after federal and state subsidies were withdrawn. Major stills costing $20 million and more were built, and many closed within three years, after losing the subsidies. In those years, each automobile would consume in calories what nearly two dozen people would consume in the same period. American farmers learned a valuable and painful lesson about the potential of alcohol fuel production to meet the enormous energy demands of that time. Soil loss accelerated during this period, and farmers gradually learned to curtail their alcohol-production programs to a very moderate level.

Another source of energy comes from the "Multiple Purpose 40." Leaf and stem material are harvested from a herbaceous polyculture after the early summer seed harvest and are converted into methanol, equivalent to two to five barrels of crude oil each year. In the fall, some of the net wood production of the woodlot and orchard is also converted. Upon arrival at the still, all organic matter is weighed, moisture is determined, and nutrients are calculated. The farmer may sell some or all of his alcohol into the public sector, but the nutrients left over after distillation are returned to the farm and are usually spread on the field or woodlot from which they were taken. This is to prevent soil mining and reduce the amount of chemical fertilizer applied.

One concern that is constantly discussed and fine tuned has to do with what tools and equipment should be owned and operated by the farm and which ones made available through the rental place in the village. At this time the rental place provides an Easy Flo fertilizer distributor (for phosphorus and nitrogen), a chisel that is attached to the tractor to break soil-bound soils, seedbed-preparation equipment for the annual crops, and numerous other pieces of equipment that are used infrequently.

People on this land have a deep distrust of commercially produced chemicals being introduced on their land. It is amazing that this distrust began to develop some 40 years ago in the churches. In many seminaries during the 1980s, cadres of students began to debate the possibility that the Genesis version of the Creation had contributed to much of the environmental problem. During the 1970s, the question of *dominion* had been much discussed. Since most defenders of the Genesis story had insisted that *dominion* was not the current word, but that *stewardship* was implied, church people began to relax. That turned out to be a rather unimportant consideration. During the 1980s another discussion began, much more quietly. The emphasis this time was on the cultural impact of a subtlety in our religious heritage. The culture had fostered, however unwittingly, the belief that humans are a separate creation. After all, the biblical creation story held that the earth and the living world were created, and then there was a pause. Following the pause, in a special effort, came human beings. But our biologists in the last century demonstrated that the same 20 amino acids are in the redwood, the snail, the human, and the elm tree, as well as in the lowly microbe. Furthermore, the nucleotides that make up the code are mostly the same throughout. Native Americans had talked about Brother Wolf and Sister Tree long before these discoveries. Now in our churches it is frequently mentioned that our cells have had no evolutionary experience with such and such a pesticide, or that the concentration of a "natural" chemical much greater than our tissues have ever experienced is to be avoided. A toxic level is defined as a quantity beyond the evolutionary standards of our cells.

Because a sustainable agriculture is more important than one that is highly productive, upland crops consist of recently developed herbaceous perennial polycultures. The polycultures are ensembles of species developed by the land grant universities through the experimental stations. Perennials were selected because of their soil-building capability. High-yielding, nutritious seed-producing perennials were first inventoried in numerous experimental gardens. Next, an intense selection program was initiated to increase the yields of individual species. Later, thousands of species combinations were tried. From then on, plant breeders sought to improve performances of individual species within the polyculture environment.

These perennial polycultures have several distinct advantages over the former annual monocultures.

First, soil loss has been reduced to replacement levels. We had expected this, for the reduction of soil loss was a major motivation behind the extensive research. Second, spring water has returned to the area. Many springs are now trickling all year, and the microhydroelectric capacity has increased, along with a rise in the water table. Land with perennial vegetation has become a huge battery for stored "electricity." A third advantage is that the energy required for maintenance and harvest after the initial planting is just 5 percent of that required by the former high-yielding monocultures of annuals. And finally, although the usual pathogens and insects are still around, they do not reach epidemic proportions.

Our particular farm has fields consisting mostly of grasses, a few legumes, and even members of the sunflower family. Some of the fields are harvested in early summer, some in the fall. The early summer or July harvest in one field includes descendants of intermediate wheatgrass, Canada wild rye, sideoats grama, tall wheatgrass, and Stueve's lespedeza. The fall harvest consists of four grasses, a legume and a member of the sunflower family. The grasses include descendants of switchgrass, lovegrass, Indian grass, and weeping lovegrass. The legume, wild senna, and a perennial soybean provide the nitrogen plus some seed, and a high-yielding descendant of the gray-headed coneflower produces seeds with two important oils.

Some of the early objections to harvest and separation of seeds from the polycultures were quickly dampened when agricultural engineers began to invent machinery. In fact, it is ironic, but the return to polycultures became possible only in our age of mechanization. Some have since made the argument that monoculture arose because of the need to harvest small seeds efficiently when all we had was hand labor. The age of mechanization, then, has allowed us to develop an agriculture with a vegetative structure that closely mimics that of preagricultural times. Much of the machinery has allowed our psyches to resemble those of hunters and gatherers again, but of course in a modern context.

The fossil fuels used during the transition era, 1985–2025, as we moved from mining and destruction of land as a way of life to the solar age, afforded us opportunities not only in plant breeding, but in animal improvement as well. This period gave us the chance to develop crops that were less dependent on humans. The same was true with the livestock. For example, the American bison was crossed with domestic cattle, and the thicker hides made the critters more resistant to severe winters.[2] In a way, we are now using solar energy (stored in grass) to maintain barns—the hides of animals. Protective shelter made of lumber for large animals is not necessary.

Livestock are moved from one polyculture to

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[1] Nationwide, roughly 15%, or approximately 100 million acres of cropland, is devoted to growing alcohol fuels. The yield amounts to about 50 million barrels of oil equivalent. An additional seven million barrels equivalent is gained in the form of methanol from the farm. In 1979, this would have amounted to only a three-day supply of oil, or less than 1% of the annual consumption.

[2] Grandparents amuse the children with stories about square tomatoes and featherless chickens. The featherless chicken was developed in the 1970s by reductionistic technologists who thought they would help corporate chicken growers and processors cut costs in cleaning chickens. The consequence was a funny-looking chicken that required such a warm environment that the energy costs were in excess of the cleaning costs. The moral of the story is that big money is a true license for big foolishness.